

WHAT IS CLAIMED IS:

1. In combination for providing signals at different positions in a patient's heart,

a vest constructed to be worn by the patient,

5 a plurality of electrodes,

a plurality of positions in the vest for receiving the electrodes, individual positions in the plurality being disposed to receive the electrodes for measuring the characteristics of the patient's heart when the patient has a small, medium or large size, thereby to obtain signals indicating the characteristics of the patient's heart when the patient has a small, medium or large size, and

10 amplifiers responsive to the signals on the electrodes at the individual positions in the vest for providing signals indicating the characteristics of the patient's heart at the different positions for the patient when the patient has a small, medium or large size.

15 2. In a combination as set forth in claim 1 wherein

the electrodes are positioned at the individual positions in the vest to measure V_1 - V_6 positions in the heart for the patient when the patient has a small, medium or large size and wherein

20 the amplifiers provide the signals at the individual ones of the V_1 - V_6 positions of the patient's heart when the patient has the small, medium or large size.

3. In a combination as set forth in claim 1 wherein

the electrodes measure individual ones of the V_1 - V_6 positions in the patient's heart when the patient has the small, medium or large size, and wherein

the amplifiers provide signals indicating the characteristics of the patient's heart at the individual ones of the V_1 - V_6 positions for the patient when the patient has the small, medium or large size.

4. In a combination as set forth in claim 1 wherein

5 the positions in the vest are disposed in rows and columns and wherein

each of the amplifiers provides indications of the heart in the individual ones of the rows at an individual one of the columns when the patient has a small, medium or large size.

5. In a combination as set forth in claim 1 wherein

10 the electrodes at the individual positions are provided with pressures against the body of the patient of at least a particular value to facilitate the production by the patient of signals indicating the characteristics of the patient's heart at the individual positions when the patient has the small, medium or large size.

6. In a combination as set forth in claim 2 wherein

15 the electrodes measure individual ones of the V_1 - V_6 positions in the heart for the patient when the patient has the small, medium or large size and wherein

the amplifiers provide signals indicating the characteristics of the heart at individual ones of the V_1 - V_6 positions for the patients when the patient has the small, medium or large size and wherein

20 the positions in the vest are disposed in rows and columns and wherein

each of the amplifiers provides indications of the heart in individual ones of the rows at an individual one of the columns when the patient has a small, medium or large size and wherein

the electrodes at the individual positions are provided with pressures against the body of the patient of at least a particular value to facilitate the production by the patient of signals indicating the characteristics of the patient's heart at the individual positions.

5 7. In combination for providing signal indications at individual positions in a patient's heart,

a vest constructed to be disposed on a patient's body for ambulatory movement of the patient while measurements are being made of the characteristics of the patient's heart,

10 a plurality of electrodes each providing a measurement at an individual one of the positions in the patient of the characteristics of the patient's heart at that position,

the positions on the vest constituting pluralities each plurality being provided to receive an individual one of the electrodes regardless of the size of the patient, and

15 a plurality of amplifiers, each connected to an individual one of the electrodes to receive signals from an individual one of the electrodes regardless of the size of the patient.

 8. In a combination as set forth in claim 7 including
an electrode assembly disposed on the vest and including a plurality of
20 electrodes each connected to provide the signals to an individual one of the amplifiers.

9. In a combination as set forth in claim 7 wherein
the vest is provided with rows and columns of positions and wherein

the electrodes are disposed in individual ones of the positions depending upon whether the patient has a small, medium or large size and wherein

each amplifier is connected to an individual one of the electrodes, when the patient has a small, medium or large size, to provide signals representing an individual position in the patient's heart regardless of the size of the patient.

10. In a combination as set forth in claim 7 wherein

the positions on the vest are disposed in rows and columns and wherein

each amplifier provides signals in an individual one of the columns when the patient has a small, medium or large size and wherein

each amplifier provides an indication of the signal on an individual one of V_1 - V_6 positions in the patient when the patient has a small, medium or large size.

11. In a combination as set forth in claim 7 wherein

the electrodes for the patient, when the patient has a small, medium or large size, are positioned on the vest so that at most only one electrode is disposed in each column of the positions on the vest regardless of the size of the patient.

12. In a combination as set forth in claim 7 wherein

each electrode is disposed on the vest with a pressure against the patient at least equal to a particular value.

13. In a combination as set forth in claim 8 wherein

the electrodes are disposed in rows and columns and wherein

each amplifier is connected to an individual one of the electrodes, when the patient has a small, medium or large size, to provide signals representing individual positions in the patient's heart regardless of the size of the patient and wherein

5 each amplifier provides signals in an individual one of the columns when the patient has a small, medium or large size and wherein

each amplifier provides an indication of an individual one of V_1 - V_6 positions in the patient and wherein

10 the electrodes for the patient, when the patient has a small, medium or large size, are positioned on the vest so that at most only one electrode is disposed in each column of the positions on the vest regardless of the patient's size and wherein

each electrode is disposed on the vest against the patient with at least a particular pressure.

14. In combination for providing signals at different positions in a patient's heart,

15 a vest having a plurality of positions for determining the characteristics of the patient's heart,

a plurality of electrodes constructed to be connected to the vest at individual ones of the different positions, and

20 an inflatable member for inflating the vest with the vest disposed on the patient to press the electrodes against the patient's body for enhancing the passage of the signals from the patient's heart to the electrodes.

15. In a combination as set forth in claim 14,

a member carried by the patient and having a plurality of terminals for receiving the signals from the different electrodes.

16. In a combination as set forth in claim 14 wherein

5 amplifiers are disposed on the member and are connected to the electrodes and wherein

the member is attached to the vest to provide for the production of signals from the patient's heart at the electrodes, while the patient is ambulatory, without affecting the characteristics of the signals from the patient's heart and wherein

10 the amplifiers are constructed to amplify the signals from the electrodes without affecting the characteristics of the signals even while the patient is ambulatory.

17. In a combination as set forth in claim 14 wherein

the vest has a plurality of positions, dependent upon the size of the patient, for receiving electrodes to measure the characteristics of the heart at positions V_1 - V_6 in
15 the patient's heart.

18. In a combination as set forth in claim 15 wherein

the member is attached to the vest to provide for the production of signals at the electrodes, while the patient is ambulatory, without affecting the characteristics of the signals produced at the different electrodes and wherein

20 the vest has a plurality of positions, dependent upon the size of the patient, for receiving electrodes to measure the characteristics of the heart at positions V_1 - V_6 on the patient's heart.

19. In a combination for providing signals at different positions in a patient's heart,

a vest constructed to be worn by the patient,

a plurality of positions on the vest, the positions being disposed in rows and

5 columns,

electrodes disposed in the vest at particular positions in the vest, the particular positions being dependent upon the size of the patient wearing the vest,

there being at most only one electrode in each column in the vest regardless of the size of the patient.

10 20. In a combination as set forth in claim 19,

a plurality of amplifiers each responsive to the signals from the electrode in an individual one of the columns, different from the other columns in which the electrodes are disposed for receiving the signals in the heart.

21. In a combination as set forth in claim 20 wherein

15 the amplifiers are attached to the vest in a closely coupled relationship to the vest to be carried by the patient in an ambulatory relationship of the patient.

22. In a combination as set forth in claim 20, wherein

the amplifiers are constructed, and are connected to the electrodes, to provide signals of stable characteristics from the electrodes regardless of the size of the patient and even while the patient is ambulatory.

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23. In a combination as set forth in claim 20 wherein

the signals from the amplifiers are independent of any noise that may result from the ambulatory nature of the patient.

24. In a combination as set forth in claim 22 wherein

the signals from the amplifiers are independent of any noise that may result from the ambulatory nature of the patient.

25. In a combination as set forth in claim 19,

an inflator for inflating the vest against the patient's body for providing an adjustable pressure of the electrodes against the patient's body.

26. In a combination as set forth in claim 19,

an inflator for inflating the vest against the patient's body to provide at least a particular pressure of each electrode against the patient's body.

27. In a combination as set forth in claim 19 wherein

each of the electrodes is individually inflated against the patient's body to provide at least a particular pressure between the electrode and the patient's body.

28. In a combination as set forth in claim 23 wherein

each of the electrodes is individually inflated against the patient's body to provide, between the electrode and the patient's body, a pressure which is at least a particular value.

29. In a combination as set forth in claim 23

a plurality of amplifiers each responsive to the signals from an individual one of the electrodes in an individual one of the columns, regardless of the patient's size, for amplifying the signals in the electrode.

5 30. In a combination as set forth in claim 24

a plurality of amplifiers each responsive to the signals from an individual one of the electrodes in an individual one of the columns, regardless of the patient's size, for amplifying the signals in the electrode.

31. In a combination as set forth in claim 34,

10 each of the electrodes is individually inflated against the patient's body to provide, between the electrode and the patient's body a pressure which at least equals a particular value.

a plurality of amplifiers provided each responsive to the signals from an electrode in an individual one of the columns, regardless of the patient's size, for
15 amplifying the signals in the electrode.

32. In a combination for providing signals at different positions in a patient's heart,

a vest constructed to be worn by the patient,

a plurality of positions disposed on the vest in rows and columns in an
20 upper left portion of the vest and in positions in a lower right portion of the vest, and

electrodes disposed on the vest in positions in the upper right portion of the vest and in positions in the lower left portion of the vest.

33. In a combination as set forth in claim 32 wherein

V_1 and V_2 electrodes are disposed in the upper right portion of the vest regardless of the size of the patient and wherein

the V_1 and V_2 electrodes in the upper right portion of the vest are
5 symmetrically disposed relative to the patient's sternum and wherein

electrodes are disposed in positions in the lower right portion of the vest regardless of the size of the patient.

34. In a combination as set forth in claim 32 wherein

V_4 , V_5 and V_6 electrodes are disposed in positions in an individual one of
10 the rows in the lower left portion of the vest regardless of the size of the patient.

35. In a combination as set forth in claim 33 wherein

a V_3 electrode is disposed in either the upper right portion or the lower left portion dependent upon the size of the patient.

36. In a combination as set forth in claim 35 wherein

V_1 and V_2 electrodes are in positions in the upper right portion of the vest in
15 the same horizontal row on opposite sides of the sternum in a symmetrical relationship with the sternum regardless of the size of the patient and wherein

V_4 , V_5 and V_6 electrodes are in positions on the lower left portion in the same horizontal row.

20 37. In a combination as set forth in claim 32 wherein

there are two (2) electrodes in the positions in the upper right portion of the rectangle and two of these electrodes are in the same row in a symmetrical relationship with the sternum of the patient regardless of the size of the patient and wherein

5 a third electrode is in either the upper right portion of the vest or the lower left portion of the vest in a row and column different from the row and columns of the first two electrodes, the positioning of the third electrode being dependent upon the size of the patient and wherein

10 there are three electrodes in position in the lower left portion of the vest and all of these are in the same horizontal row but in a row different from the rows locating the other electrodes and in columns different from the other electrodes and from one another, the positioning of the three electrodes being dependent upon the size of the patient.

38. In a combination as set forth in claim 32 wherein
15 positions are provided in the upper right portion of the rectangle and in the lower left portion of the rectangle to provide for the disposition of electrodes in particular ones of the positions for patients of small, medium and large sizes and wherein

each of the electrodes is in a different column from the other columns regardless of the size of the patient.

39. In a combination as set forth in claim 38 wherein
20 the upper right portion overlaps the lower left portion and wherein

at least two (2) electrodes are disposed in positions in the upper right portion regardless of the size of the patient and wherein

three electrodes are disposed in the positions in the lower left portion regardless of the size of the patient and wherein

a sixth electrode is disposed in either the upper right portion of the vest or the lower left portion of the vest dependent upon the size of the patient.

40. In combination for providing signals at different positions in a patient's heart,

5 a vest constructed to be worn by the patient,

a first plurality of positions in the upper left portion of the vest and a second plurality of positions in the lower right portion of the vest,

the positions in the upper left portion and the lower right portion of the vest defining rows and columns, and

10 electrodes disposed in particular ones of the positions in the upper left portion and the lower right portion of the vest for providing signals indicative of the characteristics of the heart regardless of the size of the patient.

41. In a combination as set forth in claim 40,

15 the electrodes constituting first electrodes and being disposed relative to the patient's heart and being operative to produce signals indicative of V₁-V₆ positions in the heart regardless of the size of the patient.

42. In a combination as set forth in claim 40,

a third plurality of positions in the lower right portion of the vest and a fourth plurality of positions in the upper left portion of the vest, and

20 the electrodes constituting first electrodes, and

second electrodes disposed in particular ones of the third and fourth positions for providing signals indicative of the characteristics of the heart at these positions.

43. In a combination as set forth in claim 40,

the second electrodes being disposed relative to the patient's heart and being operative to produce signals indicative of relatively rare heart problems in comparison to the heart problems indicated by the signals from the first electrodes.

5 44. In combination for providing signals at different positions in a patient's heart,

a vest constructed to be worn by the patient,

a plurality of positions in the vest,

a plurality of electrodes each disposed in an individual one of the plurality
10 of positions and operative to provide signals indicative of the characteristics of the heart at this position, and

a plurality of amplifiers each connected to an individual one of the electrodes to amplify the signals from the individual one of the electrodes, the amplifiers being supported by the vest to facilitate ambulatory movement of the patient with the
15 vest.

45. In a combination as set forth in claim 44,

the amplifiers being constructed to amplify the signals, without producing noise in the signals, during ambulatory movements of the patient with the vest disposed on the patient.

20 46. In a combination as set forth in claim 44 wherein

electrodes disposed in first positions in the vest provide signals indicative of relatively common problems in the patient's heart and electrodes disposed in second positions in the vest provide signals indicative of relatively rare problems in the heart.

47. In a combination as set forth in claim 46 wherein

the amplifiers are constructed to provide signals indicative of the characteristics of the heart at the positions of the electrodes without any noise resulting from any ambulatory movements of the patient.

5 48. In a combination as set forth in claim 44 wherein

electrodes disposed at first positions in the vest provide signals indicative of relatively common problems in the patient's heart and electrodes disposed at second positions in the vest provide signals indicative of relatively rare problems in the heart and wherein

10 the amplifiers are constructed to provide signals indicative of the characteristics of the heart at the positions of the electrodes without any noise resulting from any ambulatory movements of the patient.

49. In combination for providing signals at different positions in a patient's heart,

15 a vest constructed to be worn by the patient,

a plurality of positions in the vest,

a plurality of electrodes each disposed in an individual one of the positions and operative to provide signals indicative of the characteristics of the heart at this position, and

20 a plurality of amplifiers each connected to an individual one of the electrodes to amplify the signals from the individual one of the electrodes, the amplifiers being constructed to provide signals indicative of the characteristics of the heart at the positions of the electrodes without any noise resulting from any ambulatory movements of the patient.

50. In a combination as set forth in claim 49,

the electrodes being disposed in the vest at individual positions in the vest for patients of small, medium and large size.

51. In a combination as set forth in claim 49,

5 each of the electrodes being disposed in a coupled relationship with the patient's skin to apply pressure against the patient's skin with a value greater than a particular value.

52. In a combination as set forth in claim 50,

10 each of the electrodes being disposed in a coupled relationship to the patient's skin to apply a pressure to the patient's skin at a value greater than a particular value for producing signals indicative of the patient's heart at the position of the electrode.

53. In a combination as set forth in claim 49,

15 the electrodes being disposed in the vest at individual positions in the vest for patients of small, medium and large sizes to obtain signals indicative of the characteristics of the heart of the patient of small, medium and large sizes.

54. In a combination as set forth in claim 50,

each of the electrodes being disposed in a coupled relationship with the patient's skin to apply a pressure against the patient's skin of at least a particular value,

20 the electrodes being disposed in the vest at individual positions in the vest for patients of small, medium and large sizes to obtain signals indicative of the characteristics of the hearts of the patients of small, medium and large sizes.

55. In a method of providing signals at different positions in a patient's heart, the steps of:

providing a vest to be worn by the patient,

providing a plurality of positions in the vest for the reception of electrodes,

5 disposing the electrodes in the vest at individual ones of the positions dependent upon the size of the patient, and

applying the electrodes to the patient's skin at the individual ones of the positions to produce on the electrodes signals indicative of the characteristics of the heart at the positions of the electrodes.

10 56. In a method as set forth in claim 55, the step of:

adjusting the pressure applied by each electrode against the skin to maintain a pressure of the different electrodes against the skin of at least a particular value.

57. In a method as set forth in claim 55, the step of:

15 introducing the signals on the electrodes to amplifiers disposed on the vest and having characteristics of amplifying the signals, without the production of noise, while the patient is ambulatory.

58. In a method as set forth in claim 55, the step of:

20 providing the different positions on the housing in rows and columns and providing for the indication of V_1 - V_6 electrodes in columns wherein each of the electrodes is in a column different from the columns in which the other ones of the V_1 - V_6 electrodes are located.

59. In a method as set forth in claim 58 wherein

each of the amplifiers provides signals indicative of the patient's heart at the position of an individual one of the V_1 - V_6 electrodes by receiving indications from the individual one of the columns in which the individual one of the V_1 - V_6 electrodes is located.

60. In a method as set forth in claim 55 wherein

the electrodes include V_1 - V_6 electrodes and the V_1 - V_6 electrodes occupy individual positions on the vest for each of the patients whether the patients have a small, medium or large size.

61. In a method as set forth in claim 58 wherein

the sizes of the patients constitute small, medium and large and the positions of the V_1 - V_6 electrodes for patients having one of the small, medium and large sizes are different from the positions of the corresponding electrodes for patients having other ones of the small, medium and large sizes.

62. In a method as set forth in claim 57, the steps of:

providing the different positions on the housing in rows and column and providing for the indication of V_1 - V_6 electrodes in columns wherein each of the electrodes is in a column different from the columns in which the other ones of the V_1 - V_6 electrodes are located and wherein

each of the amplifiers provides signals indicative of the patient's heart at the position of an individual one of the V_1 - V_6 electrodes by receiving indications from the individual one of the columns in which the individual one of the V_1 - V_6 electrodes is located and wherein

the V₁-V₆ electrodes occupy individual positions on the vest for each of the different sizes of the patients.

63. In a method as set forth in claim 57, including the steps of:

the sizes of the patients constitute small, medium and large and the
5 positions of the V₁-V₆ electrodes for the patients having any one of the small, medium and large sizes are different from the positions of the corresponding electrodes for the patients having the other ones of the small, medium and large sizes and wherein

the different positions on the housing are provided in rows and columns and wherein the indications of the V₁-V₆ electrodes are provided in columns such that any one
10 of the electrodes is in a column different from the columns in which the other ones of the V₁-V₆ electrodes are located and wherein

each of the amplifiers provides signals indicative of the patient's heart at the position of an individual one of the V₁-V₆ electrodes by receiving indications from the individual one of the columns in which the individual one of the V₁-V₆ electrodes is
15 located.

64. In a method of providing signals at different positions in a patient's heart, the steps of:

providing a vest to be worn by the patient whether the patient has a small, medium or large size,

20 providing a plurality of positions in the vest,

disposing V₁-V₆ electrodes in the vest at individual ones of the positions dependent upon whether the patient has a small, medium or large size, and

applying the V_1 - V_6 electrodes to the patient's skin at the individual ones of the positions of the electrodes to produce on the electrodes signals indicative of the characteristics of the heart at the positions of the V_1 - V_6 electrodes.

65. In a method as set forth in claim 64 wherein

5 the V_1 - V_2 electrodes are disposed on opposite sides of the patient's sternum in a substantially symmetrical relationship with the sternum.

66. In a method as set forth in claim 64 wherein

regardless whether the patient has a small, medium or large size, the V_4 , V_5 and V_6 electrodes are disposed on a substantially horizontal line at positions below the
10 V_1 - V_2 electrodes and wherein the V_3 electrode is displaced vertically between the V_1 - V_2 electrodes and the V_4 , V_5 and V_6 electrodes and is displaced horizontally from the V_1 and V_2 electrodes and the V_4 , V_5 and V_6 electrodes.

67. In a method as set forth in claim 64 wherein

the positions are disposed in rows and columns and wherein

15 a plurality of positions are provided in each column and wherein

each of the V_1 - V_6 electrodes is disposed, regardless of whether the patient has a small, medium or large size, in a column different from the columns in which the other ones of the V_1 - V_6 electrodes are disposed.

68. In a method as set forth in claim 64 wherein

20 a plurality of amplifiers are provided and wherein

each of the amplifiers is connected to an individual one of the V_1 - V_6 whether the patient has a small, medium or large size.

69. In a method as set forth in claim 68 wherein

each of the amplifiers is provided with characteristics of amplifying the signals from the individual one of the electrodes, without the production of noise, while the patient is ambulatory.

5 70. In a method as set forth in claim 64 wherein

the V_4 , V_5 and V_6 electrodes are disposed on a substantially horizontal line at positions below the V_1 - V_2 electrodes and the V_3 electrode is disposed vertically between the V_1 - V_2 electrodes and the V_4 , V_5 and V_6 electrodes and wherein

the positions are disposed in rows and columns and wherein

10 a plurality of positions are provided in each column and wherein

regardless of whether the patient has a small, medium or large size, each of the V_1 - V_6 electrodes is disposed in a column different from the columns in which the other ones of the V_1 - V_6 electrodes are disposed and wherein

a plurality of amplifiers are provided and wherein

15 each of the amplifiers is connected to receive the outputs from the electrode in any of the positions in an individual one of the columns whether the patient has a small, medium or large size and wherein

each of the amplifiers is provided with characteristics of amplifying the signals from the electrode in the individual one of the columns, without the production of
20 noise, while the patient is ambulatory.

71. In a method of providing signals at different positions in a patient's heart, the steps of:

providing a vest to be worn by the patient,

providing a plurality of positions in the vest,

disposing electrodes at individual ones of the positions in the vest,

applying the electrodes to the patient's skin at the individual ones of the positions to produce at the electrodes signals indicative of the characteristics of the patient's heart at the positions of the V_1 - V_6 electrodes,

providing a plurality of amplifiers each having characteristics of amplifying the patient's heart signals at an individual one of the electrodes, without any production of noise while the patient is ambulatory, thereby providing stable signals from the patient's heart, and

connecting each of the amplifiers to the individual one of the electrodes.

72 In a method as set forth in claim 71 wherein

the positions on the vest are disposed in rows and columns and wherein

the electrodes are disposed at positions in the rows and columns such that each one of the electrodes is in an individual one of the columns different from the columns in which the other ones of the electrodes are disposed.

73. In a method as set forth in claim 71 wherein

the electrodes constitute V_1 - V_6 electrodes and wherein

the V_1 - V_2 electrodes are disposed in the same row on opposite sides of the patient's sternum and wherein

the V_4 , V_5 and V_6 electrodes are disposed in different columns in the same row and wherein

the V₃ electrode is disposed in a different row and column than the rows and columns in which the other ones of the V₁-V₆ electrodes are disposed.

74. In a method as set forth in claim 71 wherein

the V₁-V₂ electrodes are disposed on the opposite sides of the sternum in a substantially symmetrical relationship with the sternum.

75. In a method as set forth in claim 71 wherein

each of the amplifiers is connected to receive the signals from one of the electrodes in the different positions in an individual one of the columns.

76. In a method as set forth in claim 71 wherein

each of the electrodes is disposed at individual positions dependent upon the size of the patient.

77. In a method as set forth in claim 71 wherein

the electrodes constitute V₁-V₆ electrodes and wherein

the V₁-V₂ electrodes are disposed in the same row on opposite sides of the patient's sternum and wherein

the V₄, V₅ and V₆ electrodes are disposed in different columns in the same row and wherein

the V₃ electrode is disposed in a different row and column than the rows and columns in which the other ones of the V₁-V₆ electrodes are disposed and wherein

the V₁-V₂ electrodes are disposed in a substantially symmetrical relationship with the plaintiff's sternum on the opposite sides of the sternum and wherein

each of the amplifiers is connected to receive the signals from one of the electrodes in the different positions in an individual one of the columns and wherein

each of the electrodes is disposed at individual positions dependent upon the size of the patient.